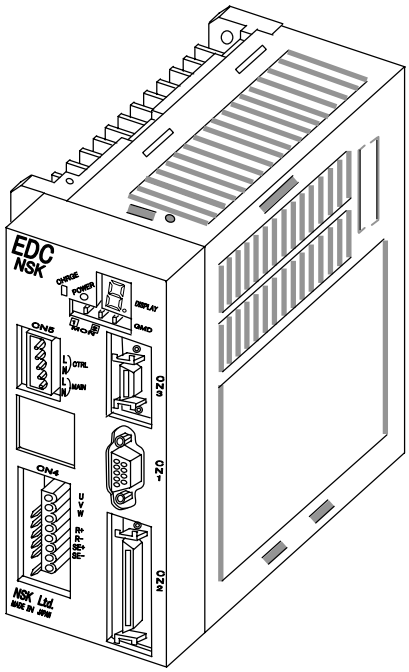
NSK

Megatorque® Motor System
User's Manual
(Supplement to the EDC Driver Unit System)



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EC-T

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1. Introduction

- This is the supplementary of the instruction manual “EDC Driver Unit System (Document Number: C20158).” This supplement describes the Megatorque Motor System composed of the EDC Driver Unit and the PN series Megatorque Motor. Please refer to the above mentioned instruction manual (Document No.C20158) for items not described in this document.

1.1. Precautions for Use

⚠ *Warning : Be sure not to activate the dynamic brake in the following conditions. Otherwise the dynamic brake circuit may break and the Motor will enter in a “free run” state, leading to possible injuries.*

◊ Do not activate the dynamic brake in normal operations. Stop the Motor by a control command, not by the dynamic brake. The dynamic brake is an auxiliary function to stop the Motor immediately in an emergency. In the middle of operation, an alarm, a warning or the “Emergency stop” input activates the dynamic brake.

- Warnings that initiate “Servo-off” state are “A3” (Software thermal), “C0” (Position command/Feedback error), “C5” (Field bass error), “F5” (Program error), and “F8” (Automatic tuning error).

◊ The load inertia to a Motor must be 70 times or less than the Motor inertia (100 times for the PS1, PS3 and PN2 type Motors). In case of an indexing operation, a position command shall be 360 degrees or less, while the maximum speed for continual rotation must be 0.5 sec^{-1} or less.
(However, there may be a possibility to exceed the above limits in some cases. Please consult NSK when you require a close investigation on the limits.)

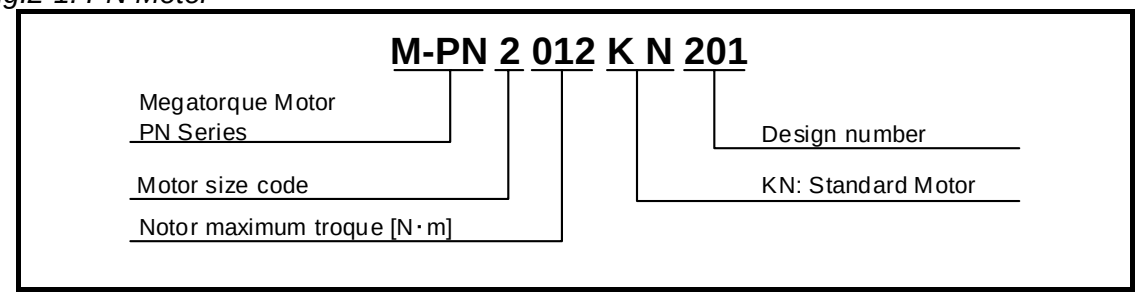
◊ For the PN4180 Motor, be sure to stop the Motor for 20 minutes or longer when you stop it by the dynamic brake.

⚠ *Caution: When the Motor is continually accelerating a high inertial load with high acceleration, the system constantly outputs a high torque exceeding the rated torque, and thus likely to activate the warning “A3” (Software thermal). In such a case take a remedy to decrease the load inertia or to lower the speed.*

2. Reference Number and Coding

2. 1. PN Series Megatorque Motor

Fig.2-1: PN Motor



2. 2. EDC Driver Unit for PN Series Megatorque Motor

Fig. 2-3: EDC Driver Unit for PN2012 type Motor

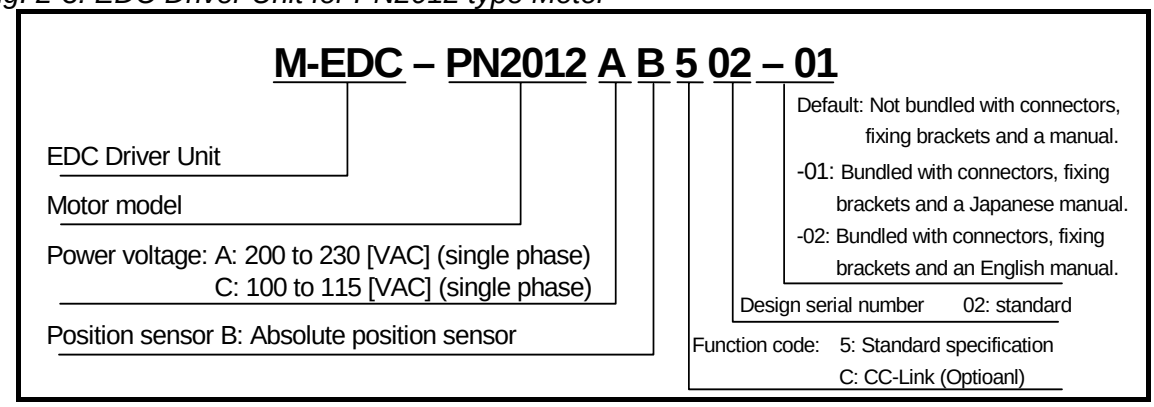

M-EDC – PN2012 A B 5 02 – 01
EDC Driver Unit
Motor model
Power voltage: A: 200 to 230 [VAC] (single phase)
C: 100 to 115 [VAC] (single phase)
Position sensor B: Absolute position sensor
Function code: 5: Standard specification
C: CC-Link (Optioanl)
Design serial number 02: standard
Default: Not bundled with connectors, fixing brackets and a manual.
-01: Bundled with connectors, fixing brackets and a Japanese manual.
-02: Bundled with connectors, fixing brackets and an English manual.

Fig.2-4: EDC Driver Unit for PN3045 types Motor

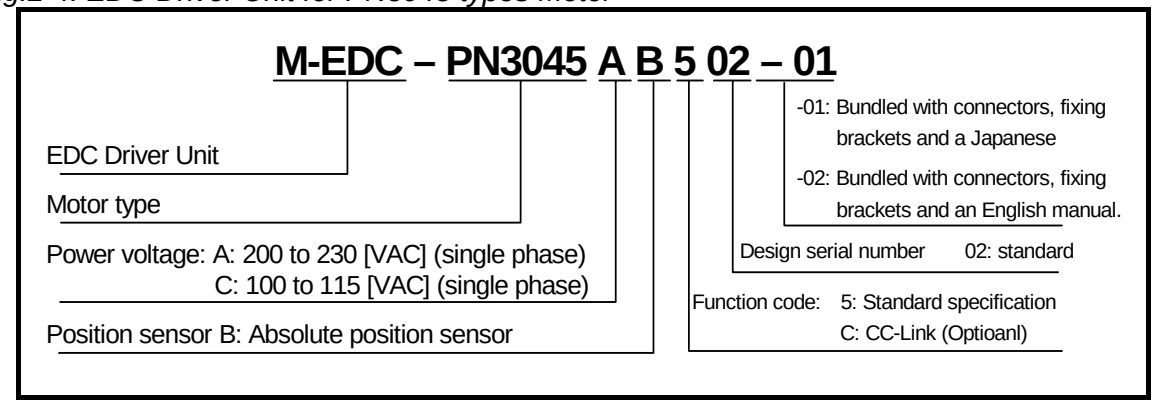
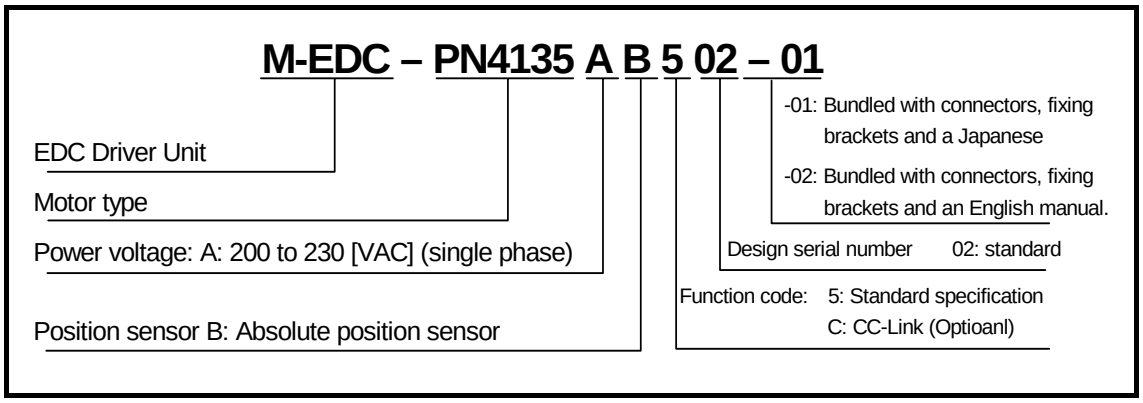
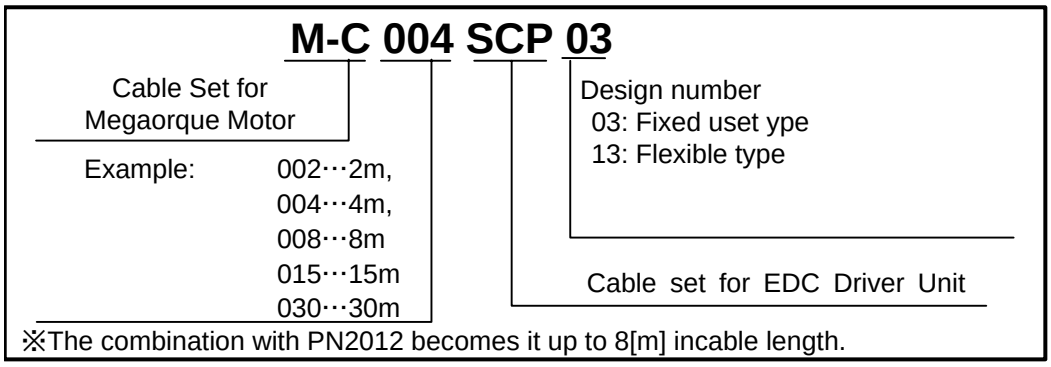

M-EDC – PN3045 A B 5 02 – 01
EDC Driver Unit
Motor type
Power voltage: A: 200 to 230 [VAC] (single phase)
C: 100 to 115 [VAC] (single phase)
Position sensor B: Absolute position sensor
Function code: 5: Standard specification
C: CC-Link (Optioanl)
Design serial number 02: standard
-01: Bundled with connectors, fixing brackets and a Japanese
-02: Bundled with connectors, fixing brackets and an English manual.

Fig.2-5: EDC Driver Unit for PN4135, and PN4180 types Motor


M-EDC – PN4135 A B 5 02 – 01
EDC Driver Unit
Motor type
Power voltage: A: 200 to 230 [VAC] (single phase)
Position sensor B: Absolute position sensor
-01: Bundled with connectors, fixing brackets and a Japanese
-02: Bundled with connectors, fixing brackets and an English manual.
Design serial number 02: standard
Function code: 5: Standard specification
C: CC-Link (Optioanl)

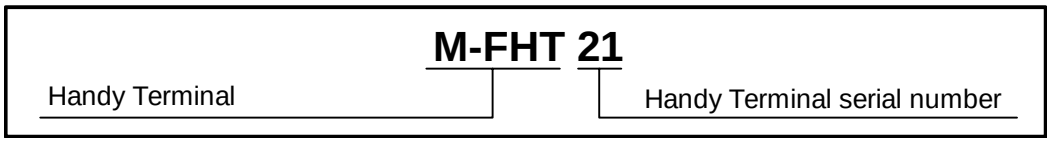
2.3. Cable Set

Fig 2-6: Reference number coding of Cable Set



2.4. Handy Terminal

Fig 2-7: Reference number coding of Handy terminal



3. Name of Each Part

Fig 3-1: PN 2012 type Motor

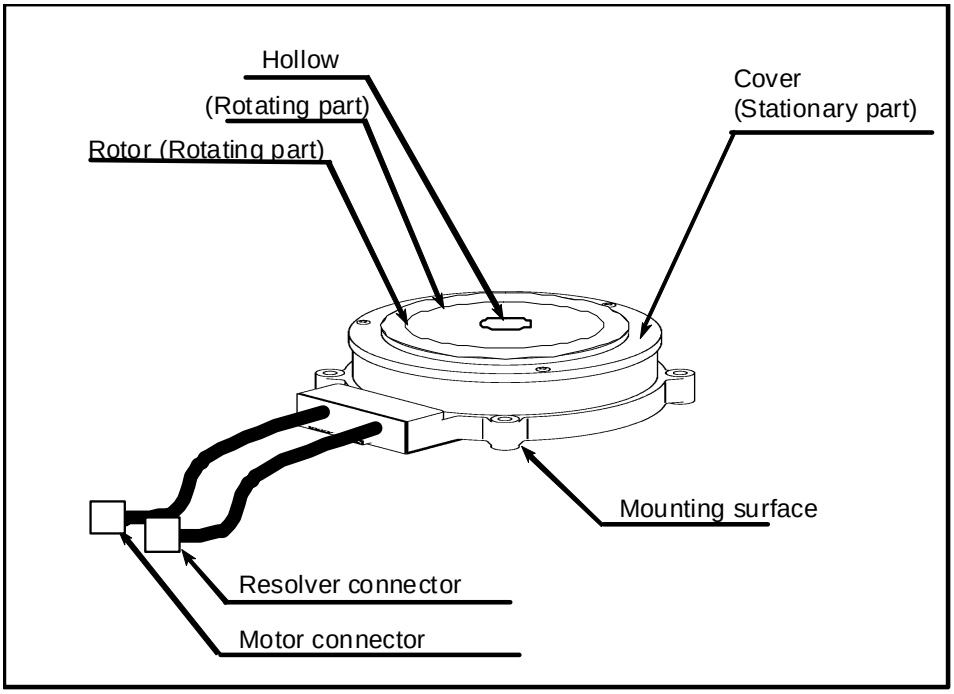
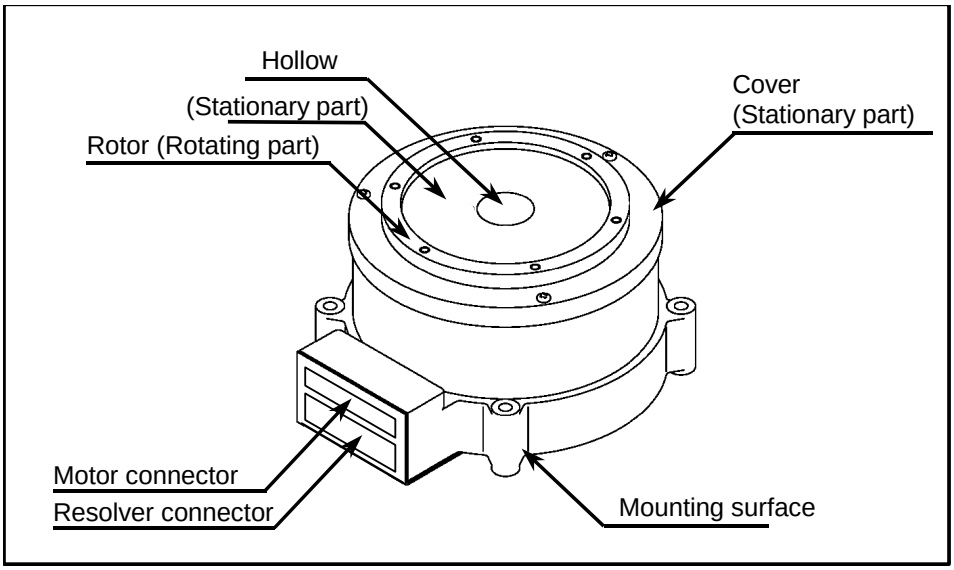


Fig. 3-2: PN3045, 4135, and 4180 type Motor



4. Combination of Motor and Driver Unit

Table4-1: Combination of PN2012 type Motor and Driver Unit

Motor diameter [mm]	Motor reference number	Driver Unit reference number ∗∗: Code for specification of bundled items.	Power voltage [VAC]	Cable reference number	Remarks
ø176	M-PN2012KN201	M-EDC-PN2012AB502-∗∗	200 to 230	M-C0∗∗SCP03 (Fixed type cable) M-C0∗∗SCP13 (Flexible type cable) ∗∗: Cable length in meters 01: 1 [m] 02: 2 [m] 03. 3 [m] 04: 4 [m] 05: 5 [m] 06: 6 [m] 07: 7 [m] 08: 8 [m]	• Pulse train input
		M-EDC-PN2012CB502-∗∗	100 to 115		
		M-EDC-PN2012ABC02-∗∗	200 to 230		• CC-Link
		M-EDC-PN2012CBC02-∗∗	100 to 115		

Table4-2: Combination of PN3045, PN4135, PN4180 type Motor and Driver Unit

Motor diameter [mm]	Motor reference number	Driver Unit reference number ∗∗: Code for specification of bundled items.	Power voltage [VAC]	Cable reference number	Remarks
ø210	M-PN3045KN001	M-EDC-PN3045AB502-∗∗	200 to 230	M-C0∗∗SCP03 (Fixed type cable) M-C0∗∗SCP13 (Flexible type cable) ∗∗: Cable length in meters 01: 1 [m] 02: 2 [m] 03. 3 [m] 04: 4 [m] 05: 5 [m] 06: 6 [m] 07: 7 [m] 08: 8 [m] 09: 9 [m] 10: 10 [m] 15: 15 [m] 20: 20 [m] 30: 30 [m]	• Pulse train input
		M-EDC-PN3045CB502-∗∗	100 to 115		
		M-EDC-PN3045ABC02-∗∗	200 to 230		• CC-Link
		M-EDC-PN3045CBC02-∗∗	100 to 115		
ø280	M-PN4135KN001	M-EDC-PN4135AB502-∗∗	200 to 230		• Pulse train input
		M-EDC-PN4135ABC02-∗∗			• CC-Link
	M-PN4180KN001	M-EDC-PN4180AB502-∗∗			• Pulse train input
		M-EDC-PN4180ABC02-∗∗			• CC-Link

5. Motor Specifications

Table 5-1: PN series Megatorque Motor

Item [Unit] \ Reference number		M-PN2012KN201	M-PN3045KN001	M-PN4135KN001	M-PN4180KN001
Motor outside diameter	[mm]	ø176	ø210	ø280	
Maximum output torque	[N•m]	12	45	135	180
Rated output torque	[N•m]	2	15	45	60
Motor height	[mm]	35	85	95	112
Motor hollow diameter	[mm]	36	56	50	50
Maximum velocity	[s^{-1}]	2	3		
Rated velocity	[s^{-1}]	1	1		
Resolution of position sensor	[Count/rev.]	2 621 440			
Absolute position accuracy	[arcsec.]	90 *1, *3			
Repeatability	[arcsec.]	±2			
Allowable axial load	[N]	1 000	4500	9500	
Allowable radial load	[N]	20 *2	80	160	200
Rotor inertia	[kg•m^2]	0.0024	0.011	0.057	0.065
Recommended moment load	[kg•m^2]	0.02 to 0.24	0.11 to 0.77	0.57 to 3.99	0.65 to 4.55
Mass	[kg]	3.7	13	26	31
International protection code		IP30 equivalent			
Environmental conditions		Ambient temperature: 0 to 40[°C] Humidity: 20 to 80 [%], In door use only. Free from condensation, dust and corrosive gas.			

• SI Unit System: 1N = 0.102 kgf. 1N•m = 0.102 kgf•m

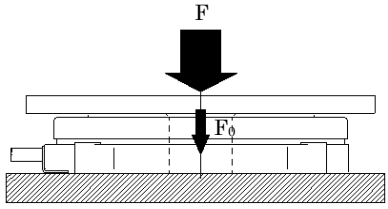
*1. This accuracy is guaranteed at the temperature of 25 ±5 [°C].

*2. The use condition must clear the recommended moment load and the maximum radial load of 300[N].

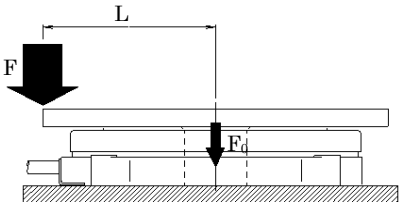
*3.The cable length of PN2012 becomes it up to 8[m] .

⚠ *Caution : Axial load Fa and Moment load M shall be less than the limits specified in the above table.*

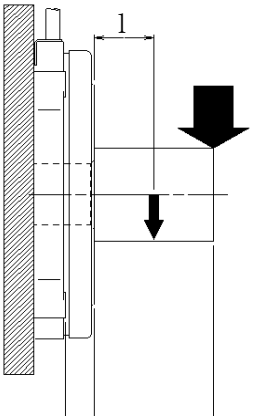
Fig. 5-1: Loads applied to a Motor



1) When F is an external force
- Axial load: $F_a=F+F_0$
- Moment load: M=0



2) When F is an external force
- Axial load: $F_a=F+F_0$
- Moment load: M=F×L



3) When F is an external vertical load
- Radial force: $F_r=F+F_0$
- Moment load: $M=F\times(L+A)+F_0\times(l+A)$

Table 5-2：Dimension A (distance between the bearing and the rotor)

Motor reference number	M-PN2012KN201	M-PN3045KN001	M-PN4135KN001	M-PN4180KN001
A [mm]	16.7	33.8	54.2	54.2

6. External Dimensions

6.1. PN Series Megatorque Motors

⚠ *Caution: Bending radius of the outgoing lines of Motor cable (ø7) and resolver cable (ø7) shall be R30 [mm] or less.*

⚠ *Caution: Do not use outgoing lines of Motor cable and Resolver cable as a part of the flexible cable.*

⚠ *Caution: Do not apply any stress (tension or vibration) to the connecting position of the outgoing lines and a connector. If not, it may result in a disconnection or a loose connection.*

Fig. 6-1: PN2012 type Motor

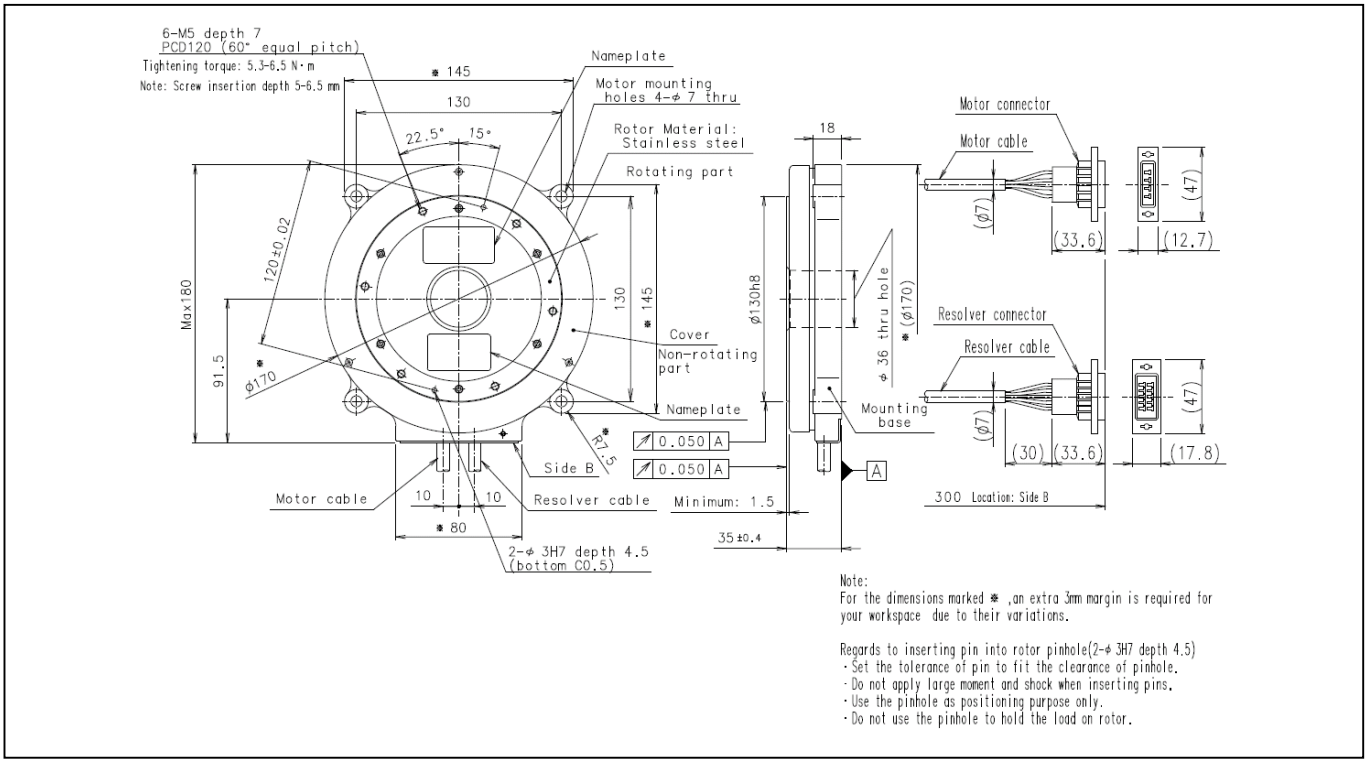

6-M5 depth 7
PCD120 (60° equal pitch)
Tightening torque: 5.3-6.5 N·m
Note: Screw insertion depth 5-6.5 mm
Nameplate
Motor mounting holes 4-ø 7 thru
Rotor Material: Stainless steel
Rotating part
Cover
Non-rotating part
Nameplate
Side B
Motor cable
Resolver cable
Minimum: 1.5
2-ø 3H7 depth 4.5 (bottom C0.5)
Motor connector
Motor cable
Resolver connector
Resolver cable
Mounting base
300 Location: Side B
Note:
For the dimensions marked ※ ,an extra 3mm margin is required for your workspace due to their variations.
Regards to inserting pin into rotor pinhole(2-ø 3H7 depth 4.5)
· Set the tolerance of pin to fit the clearance of pinhole.
· Do not apply large moment and shock when inserting pins.
· Use the pinhole as positioning purpose only.
· Do not use the pinhole to hold the load on rotor.

Fig. 6-2: PN3045tyoe Motor

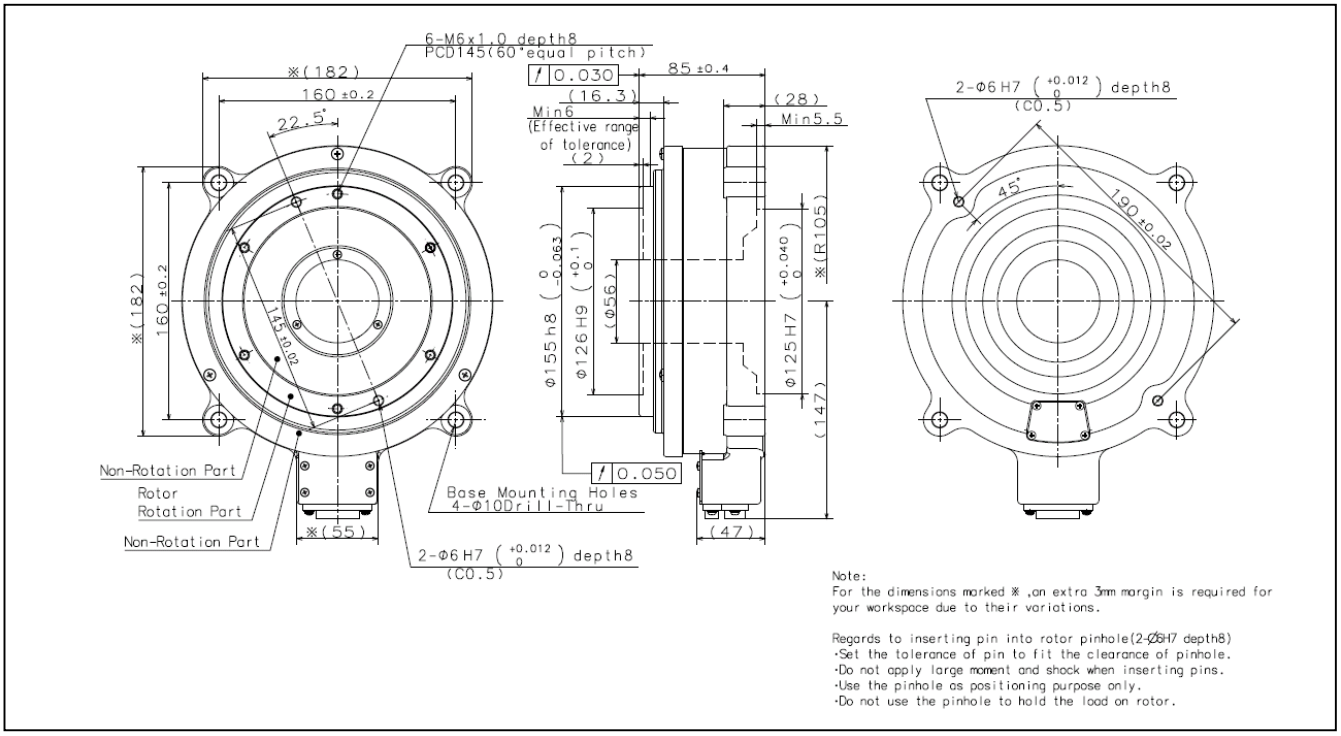
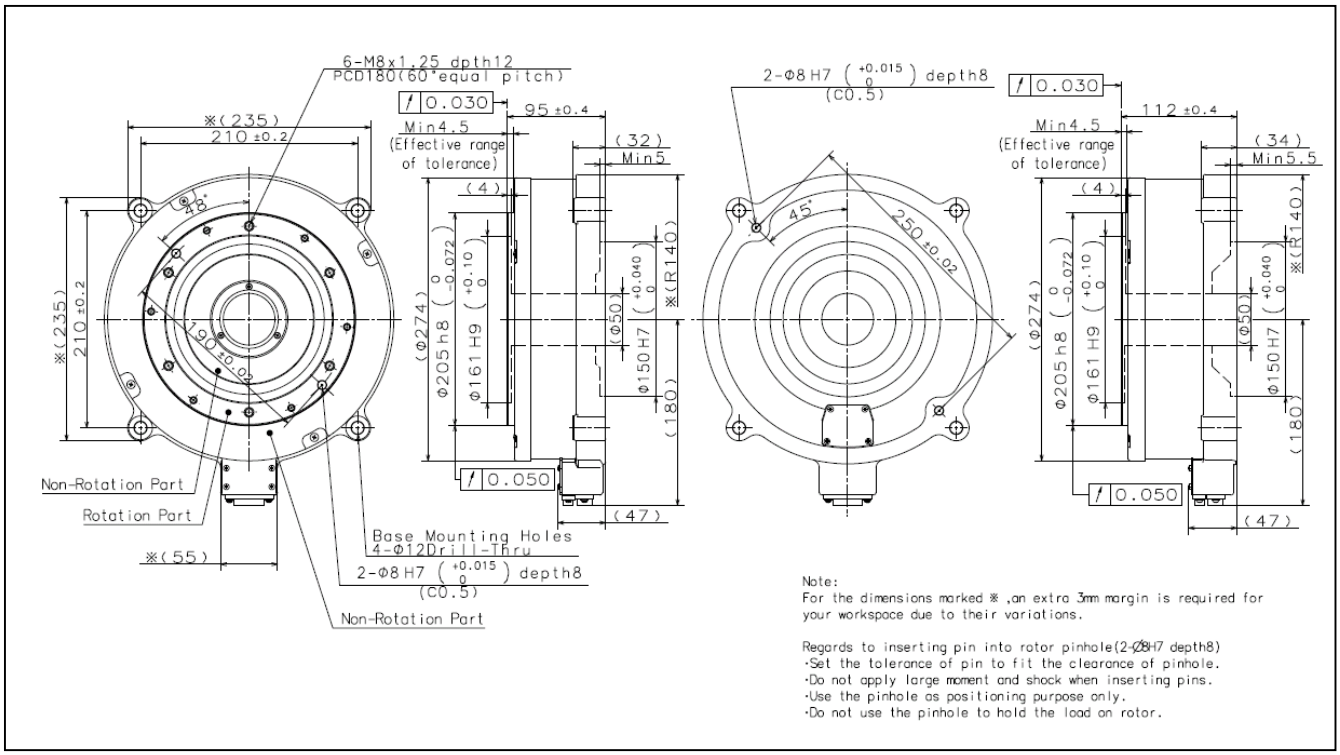


Fig 6-3: PN4135 and PN4180 type Motor



6.2. Driver Unit

Fig.6-4 : EDC Driver Unit for PN2012 type Motor

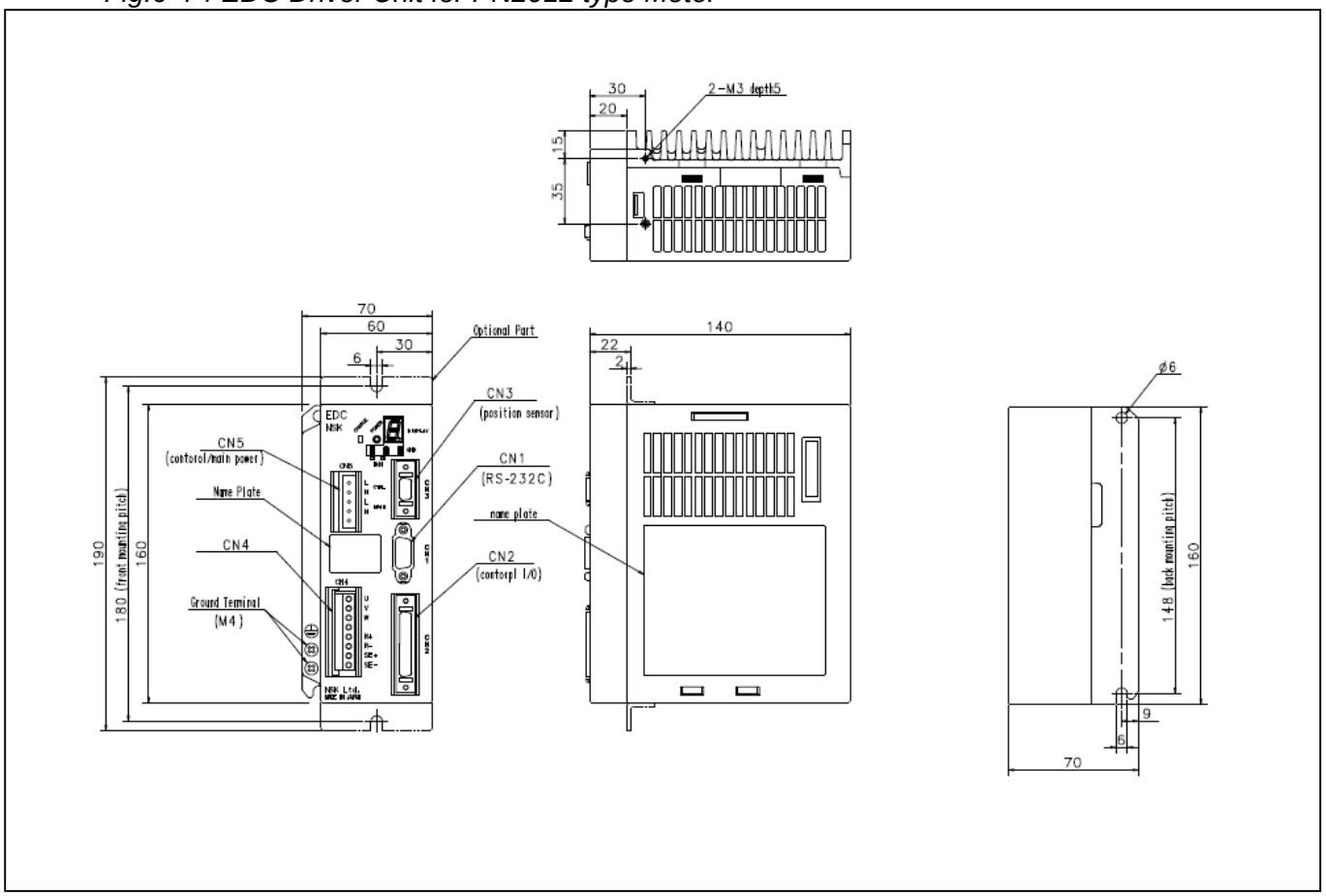


Fig. 6-5: CC-Link Compatible EDC Driver Unit for PN2012 type Motor

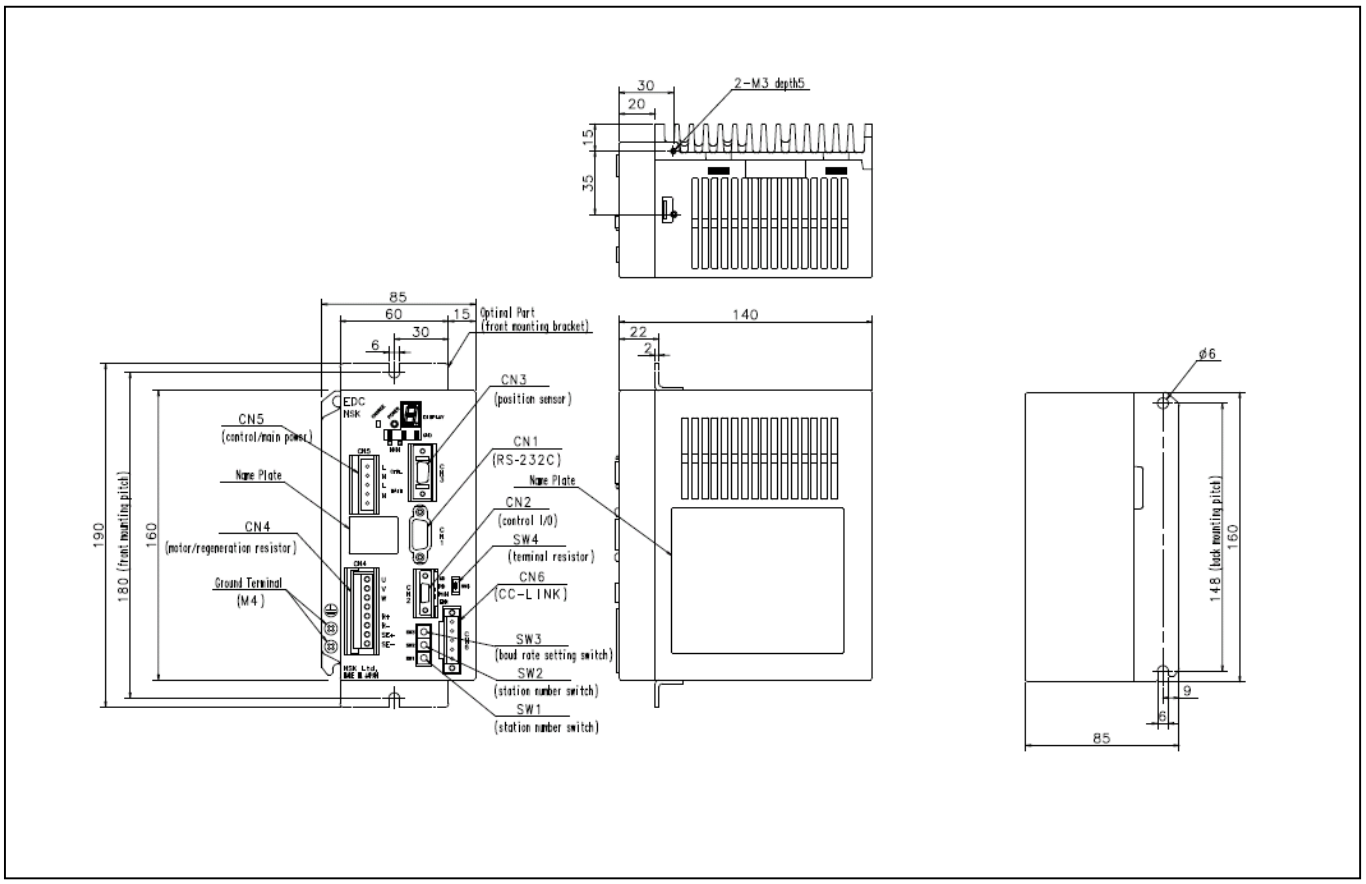


Fig. 6-6 EDC Driver Unit for PN3045, PN4135 and PN4180 Megatorque Motors

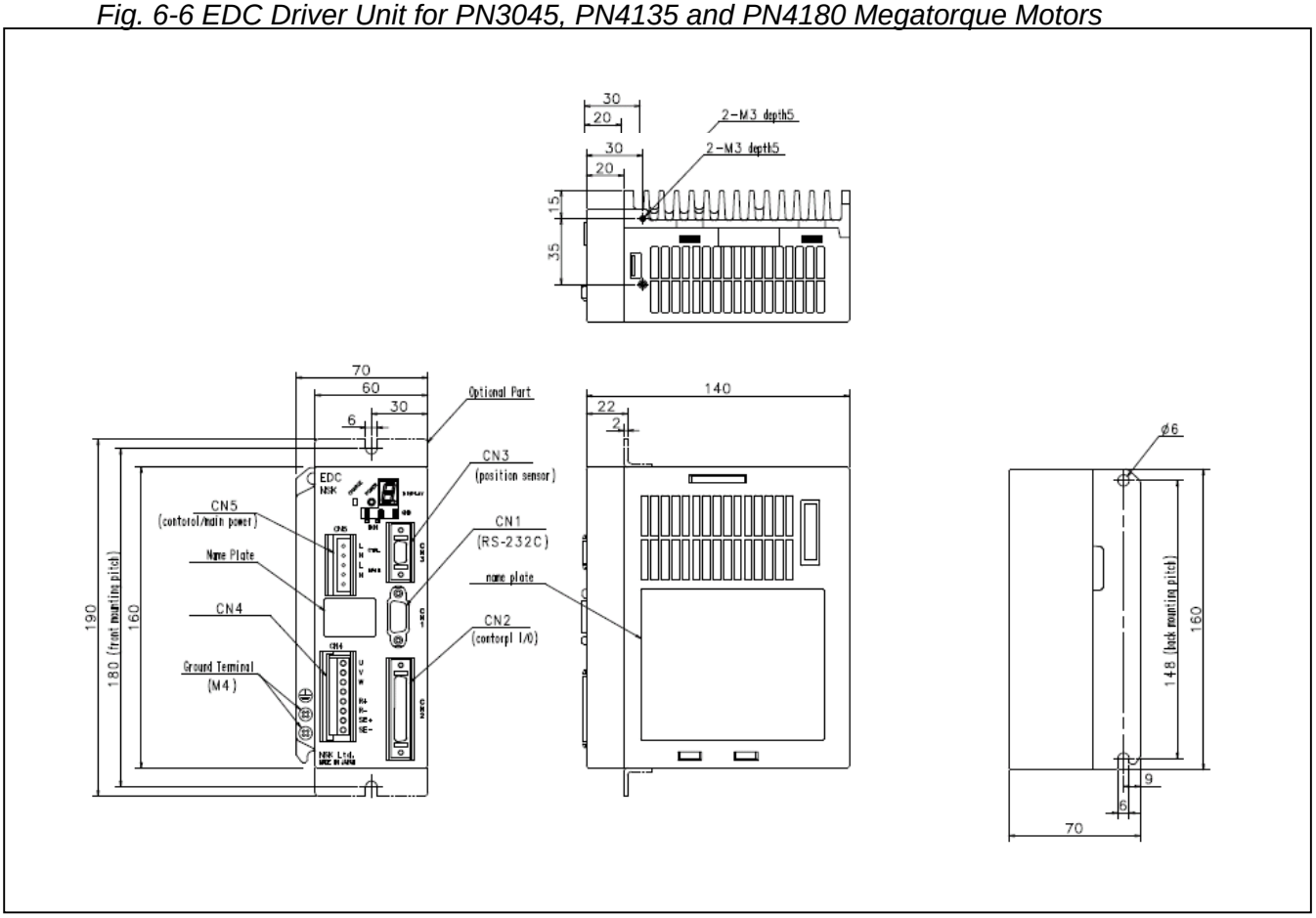
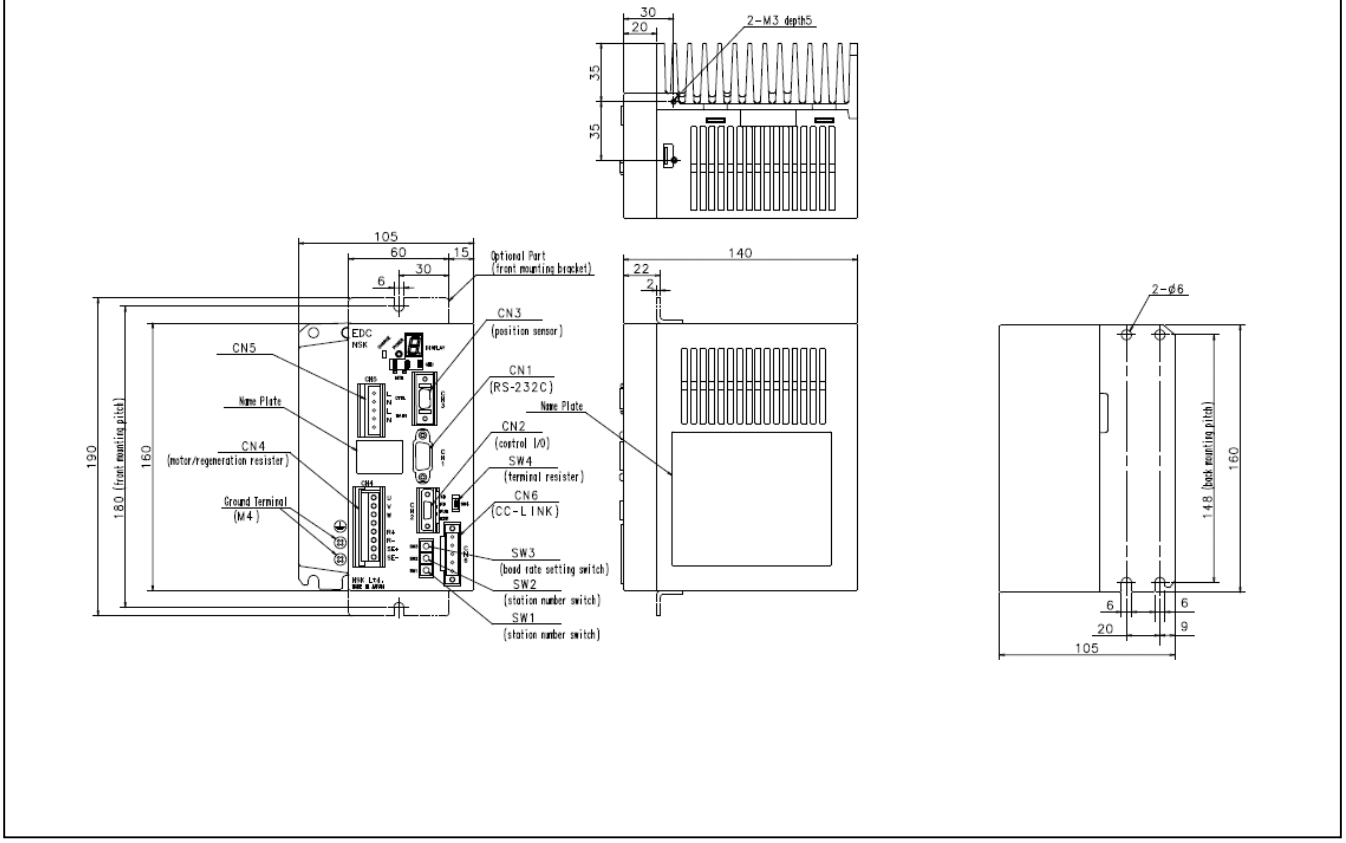


Fig. 6-7 CC-Link Compatible EDC Driver Unit for PN3045, PN4135 and PN4180 Megatorque Motors



7. Driver Unit Specifications

Table 7-1: EDC Driver Unit

Item			PN2012	PN3045	PN4135	PN4180
Output current	Rated output［Arms］		1.2	4.5	4.5	4.5
	Maximum output［Arms］		6.5	14.9	14.9	14.9
Power input	Rated capacity［kVA］		0.1	0.5	0.9	1.1
	Max. capacity ［kVA］		2.1	4.4	5.0	5.1
	Control power source		Single phase 100 to 115 [VAC] Single phase 200 to 230 [VAC] Fluctuation of voltage:±10[%] or less		Single phase 200 to 230 [VAC] Fluctuation of power voltage: ±10[%]	
	Main power source					
Position sensor resolution [count/rev]			2 621 440			
Maximum velocity [s^{-1}]			2	3		
Positioning operation mode			Program operation (256 channels), Pulse train input, RS-232C serial communication command, Jog, Home Return			
Input signal	Pulse train command		Photo coupler input: Maximum pulse frequency: 1 [MHz] Input format: CW/CCW, Pulse and direction, ΦA/ΦB Electronic gear A/B multiple available (1 000 to 5 242 880 [count/rev])			
	Control input		Photo coupler input (±Common available), 17 input ports, 24 [V] input voltage Emergency stop, Alarm clear, Over travel limit +/-, Servo ON, Program operation start, Stop, Internal program 內 channel switching (0 to 7), Jog, Jog direction, (Hold, Velocity override, Integration OFF, Home return start and Home position limit)*1			
Output signal	Position feedback signal		Signal format: ΦA/ΦB/ΦZ line drive, Free resolution setting to ΦA/ΦB available. Resolution of ΦA/ΦB: • Shipping set: 20 480 [count/rev.] (Quadrupled: 81 920 [count/rev]) • Maximum 1 310 720 [count/rev] (Quadrupled: 5 242 880 [Count/rev]) * The maximum signal frequency is limited to 781 [kHz] and thus the setting of resolution limits the maximum revolution speed. (Maximum speed: [s^{-1}] = 781 [kHz]/Resolution of ΦA [or ΦB] Resolution of ΦZ: 80 [count/rev]			
	Control output		Photo coupler output (±Common available), 7 output ports. Maximum switching capacity: 24 [VDC]/50 [mA] Driver unit ready, Warning, Over travel limit detection +/- direction, Servo state, Busy, In-position, Target proximity A (Target proximity B, Zone A•B•C, Travel limit +/-, Normal, Position error under/over, Velocity error under/over, Torque command under/over, Thermal loading under/over, Home return complete, Home position defined)*1			
Alarm			Excess error, Program error, Automatic tuning error, Position command/Feedback error, Field bus warning, Software thermal error, Home position undefined, Main AC line under voltage, Travel limit over, RAM error, ROM error, System error, Interface error, ADC error, Emergency stop, CPU error, Fieldbus error, Position sensor error, Absolute position error, Motor cable disconnected, Excess velocity, Resolver excitation amplifier alarm, Commutation error, Overheat, Main AC line over voltage, Excess current, Control AC line under voltage, Power module error			
Monitors			Analog monitor ×2 (Free range and offset setting), RS-232C monitor			
Communication			RS-232C serial communication (Asynchronous, 9 600 [bps])			
Data backup			EEPROM (Overwriting and deleting of parameters are limited to 100 000 times.)			
Others			• Automatic tuning • Function setting to Input/Output port • Temporal parameter setting by a program operation. • Individual setting of acceleration and deceleration • Acceleration profiling (Modified sine, Modified trapezoid, Cycloid and Half sine)			
Fieldbus			CC-Link Ver.1.10 compatible (Optional EDC Driver Unit compatible to CC-Link is required.)			
Environ-ment	• Ambient temperature • Storage temperature		• Ambient temperature: 0 to 50[℃] • Storage temperature －20 to 70[℃]			
	Ambient/storage humidity		90[％] or less (No condensation)			
	Vibration resistance		4.9 [m/s^2]			
Built-in function	Regeneration		Optional dump resistor available when the regeneration current is beyond the capacity of built-in resistor. (M-E014DCKR1-100, M-E014DCKR1-101) • Connect to R+,R-,SE+ and SE-. (Never short-circuit them.)			
	Dynamic brake		Functions at the state of Power-off, Servo-off and Warning. The command KB terminates the dynamic brake function. (Refer to "9.2. Glossary of Command and parameter.)			
Compatible safety regulation	UL		UL508C			
	CE Marking	LVD	EN50178			
		EMC	EMI：EN55011EMS：EN61000-6-2			
Connectors	RS-232C	CN1	D-sub 9 pins			
	Control I/O	CN2	Standard: half pitch connector 50 pins CC-Link compatible: Half pitch 10 pins			
	Position sensor	CN3	Half pitch connector 14 pins			
	Motor/Optional dump resistor	CN4	Plastic connector (UL and CE qualified)			
	Control/Main power	CN5	Plastic connector (UL and CE qualified)			
	CC-Link	CN6	Plastic connector 5 pins			
Mass [kg]			Standard: 1.1 CC-Link compatible: 1.3	Standard: 1.8 CC-Link compatible: 2.0		

*1: These functions become effective by changing some functional allocation of control Input/Output.

8. Installation

8.1. Environmental Conditions of Motor

- Use the Motor in the indoor conditions free from dust and corrosive gas.
- The operating ambient temperature of the Motor shall be 0 to 40°C.
- The PN type Megatorque Motors are neither dust-proof nor waterproof.
  Do not expose the Motor to water or oil from any source.
- It is essential to securely fix the Motor to a mounting base of which rigidity is sufficient enough. .
  Otherwise, mechanical resonance may occur.

⚠ *Warning : When fixing the Motor, use bolt holes on its bottom.*

- The flatness of the mounting surface for the Motor shall be 0.02 mm or less.
- The Motor can be mounted vertically or horizontally.

⚠ *Caution: Do not connect the outgoing lines of the Motor cable and resolver cable of the PN2012 type Motor to a moving part. The bending radius of the outgoing lines shall be 30 mm or less.*

8.2. Coupling a Load to the Motor

⚠ *Warning : Fix the load using the bolt holes on the rotor surface. Be sure to fasten the bolts firmly.*

- The table bellow shows the tightening torque of bolt and thread depth for each Motor type.

Motor type	PN2012	PN3045	PN4135	PN4180
Tightening torque [N·m]	5.3 to 6.5	7.8 or less	20 or less	20 or less
Thread depth [mm]	5 to 6.5	6 to 7.5	10 to 11.5	10 to 11.5

⚠ *Caution: When using the pinhole on the rotor, please follow the notes below.*

- Set the tolerance of pin diameter to a lose fit.
- Do not apply excessive load or shock to the Motor when inserting the pin to the pinhole.
- The pinhole is simply for positioning of a load to the Motor. Do not use the pinhole to support the load.

8.3. Confirmation of Use Conditions

- In case of the Megatorque Motor system, the moment of inertia of load is extremely higher than that of the rotor. The table bellow shows the allowable moment of inertia for each Motor type.

Table 8-1 : Allowable moment of inertia for Motor

Motor type	Moment of inertia of the rotor [kg·m^2]	Allowable moment of inertia [kg·m^2]
PN2012	0.0024	0.24
PN3045	0.011	0.77
PN4135	0.057	3.99
PN4180	0.065	4.55

⚠ *Caution: Be sure to confirm the allowable moment load and axial load to the Motor under the use conditions.*

- Please refer to "5. Motor Specifications" for the allowable moment load and axial load for each Motor.

Appendix 1: How to Check Motor Condition

■ Examine the resistance and the insulation resistance of the Motor winding to check if the Motor is in normal condition. It can be regarded as it is normal if all check results are within the specifications.

■ First, check the winding resistance including the Motor cable. If the result is not satisfactory, check the Motor only.

1. Resistance check of Motor winding

Fig A-1: Check with the cable set

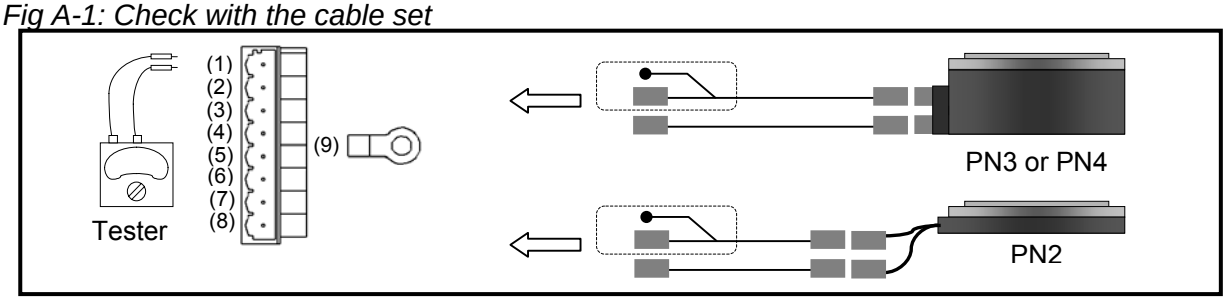
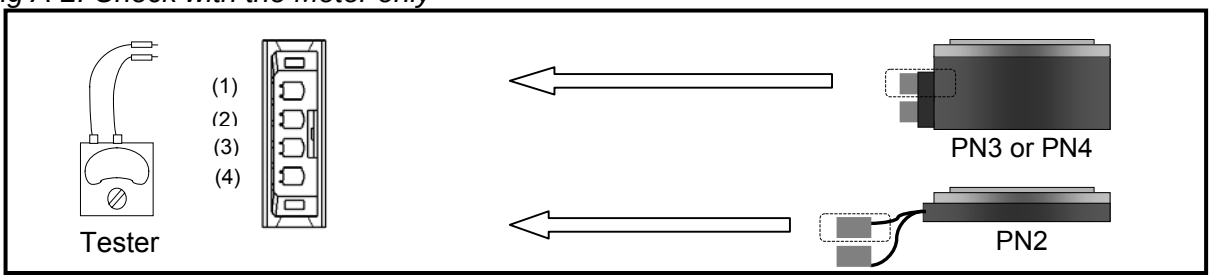


Fig A-2: Check with the Motor only



● Do not turn the rotor while checking the Motor winding.

Table A-1: Checking points

	Cable connector	Motor connector	Result
Phase UV	(1) ↔ (2) (U) (V)	(1) ↔ (2) (U) (V)	
Phase VW	(2) ↔ (3) (V) (W)	(2) ↔ (3) (V) (W)	
Phase WU	(3) ↔ (1) (W) (U)	(3) ↔ (1) (W) (U)	

Table A-2: Resistance specification of Motor winding

Motor type	Winding resistance [Ω]	Specification
PN2012	15.2	1. ± 30% of the value in the left 2. Variation between each phase UV, VW, and WU is less than 15%
PN3045	1.9	
PN4136	2.6	
PN4180	3.2	

● Please ask NSK for a Motor with special winding specifications or a Cable longer than 4 m.

2. Resistance check of the resolver winding

Fig A-3: Check with the Cable set

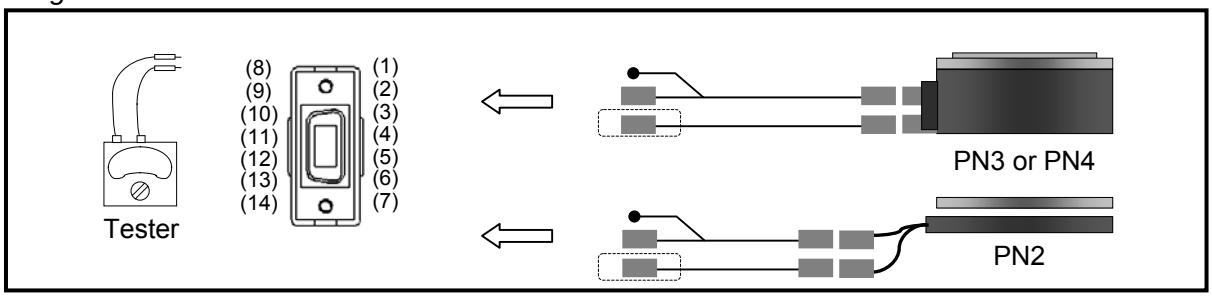


Fig A-4: Check with the Motor only

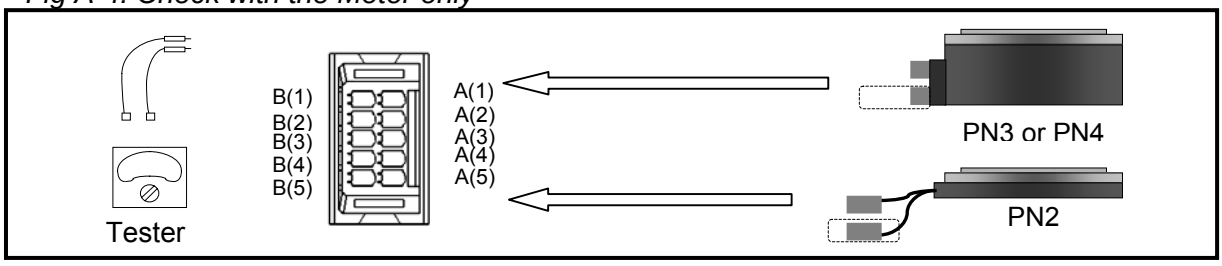
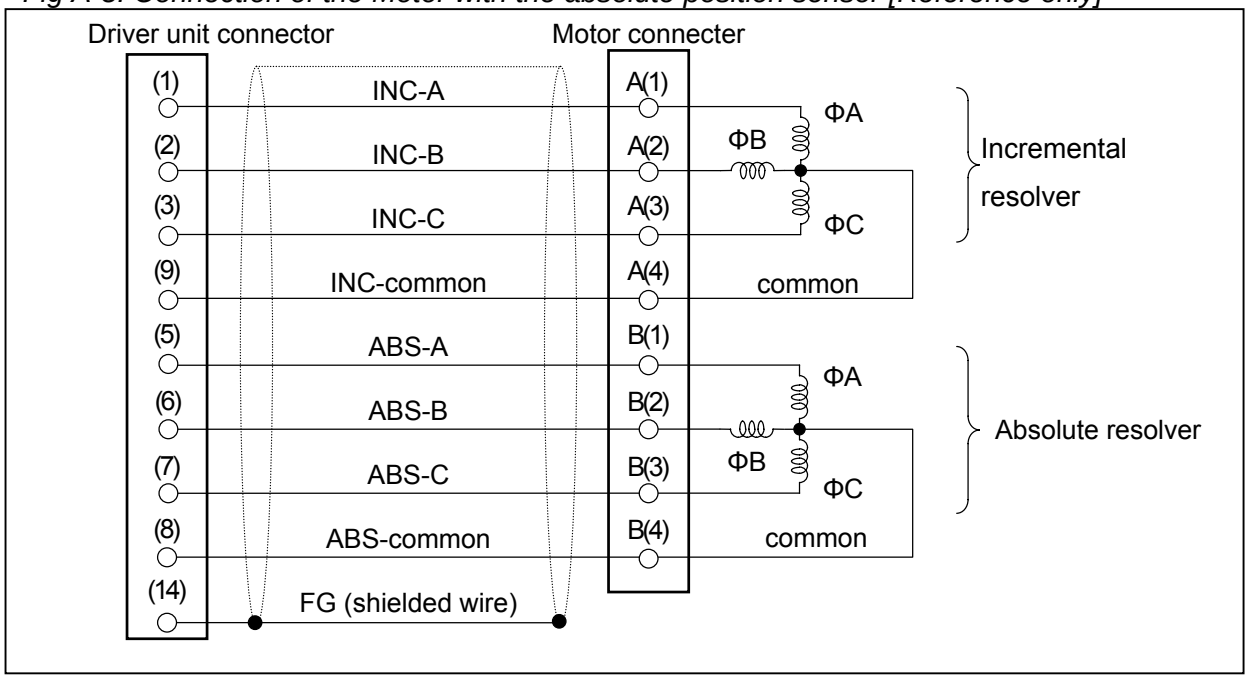


Table A-3: Checking points of the resolver with an absolute position sensor and winding resistance

	Cable connector	Motor connector	Result	Specification
INC-A	(1) ↔ (9) (INC-A) (INC･COM)	A(1) ↔ A(4) (INC-A) (INC･COM)		1.Resistance • PN2012: 7.7 ±1 Ω •PN3 and PN4: 9.8 ±1 Ω 2. Variation between each phase A, B and C shall be 1.0 Ω or less.
INC-B	(2) ↔ (9) (INC-B) (INC･COM)	A(2) ↔ A(4) (INC-B) (INC･COM)		
INC-C	(3) ↔ (9) (INC-C) (INC･COM)	A(3) ↔ A(4) (INC-C) (INC･COM)		
ABS-A	(5) ↔ (8) (ABS-A) (ABS･COM)	B(1) ↔ B(4) (ABS-A) (ABS･COM)		1.Resistance • PS1 type: 8.3 ±1 Ω • PS3 type: 9.8 ±1 Ω 2. Variation between each phase A, B and C shall be 1.0 Ω or less.
ABS-B	(6) ↔ (8) (ABS-B) (ABS･COM)	B(2) ↔ B(4) (ABS-B) (ABS･COM)		
ABS-C	(7) ↔ (8) (ABS-C) (ABS･COM)	B(3) ↔ B(4) (ABS-C) (ABS･COM)		

* Please ask NSK for the specifications of the Motor with special winding, and the Cable longer than 4 [m].

Fig A-5: Connection of the Motor with the absolute position sensor [Reference only]



3. Insulation resistance check of Motor winding

Caution: Disconnect the Motor from the Driver Unit when checking insulation resistance of the Motor.

Caution: Checking voltage must be 500[VDC] or less.

Fig A-6: Check with the Cable

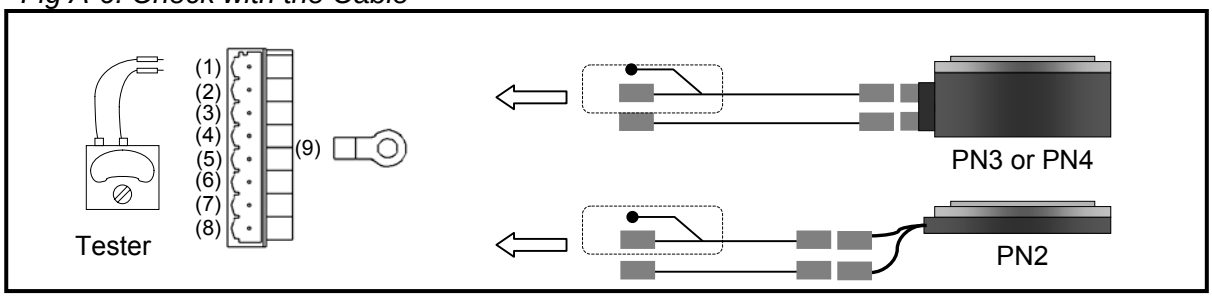


Fig A-7: Check the Motor only

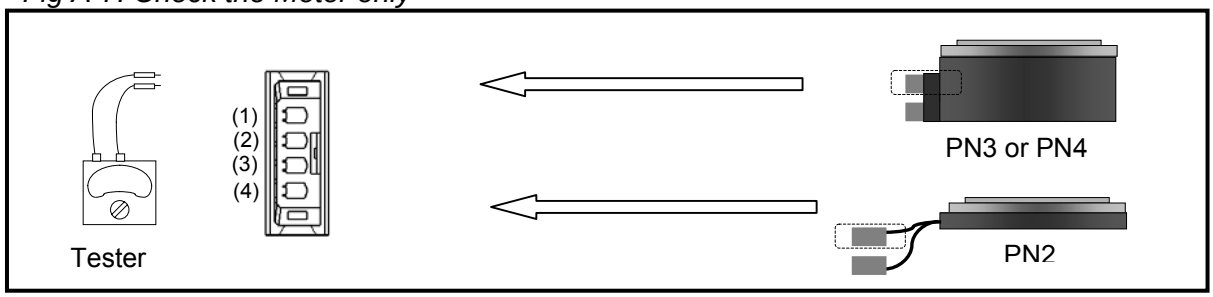


Table A-4: Checking point

	Cable connector	Motor connector	Result
øU – PE	(1) ↔ (9) (U) (PE)	(1) ↔ (4) (U) (PE)	
øV – PE	(2) ↔ (9) (V) (PE)	(2) ↔ (4) (V) (PE)	
øW – PE	(3) ↔ (9) (W) (PE)	(3) ↔ (4) (W) (PE)	

Table A-5: Specification of insulation resistance (Common to all type of Motor)

	Specification
With cable	1 [MΩ] or over
Motor only	2 [MΩ] or over

4. Visual check of the Motor and the Cables

- Check the Motor for any damage.
- Check the cable for any damage on the cable insulation.

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MEGATORQUE® MOTOR SYSTEM

PN Motor Series

EDC Driver Unit

User's Manual

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